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(54) Abstract Title

**Medical tissue resection device for removing tissue comprising a cavity of variable volume for receiving tissue & means for removing the tissue thus received**

(57) A medical tissue resection device for removing tissue comprises a body portion (10) that defines a cavity (12) for receiving tissue and means (16) for removing the tissue thus received.

The means for removing the tissue may comprise a blade (16) or a guillotine or a snare.

Preferably, the volume of the cavity is adjustable, thereby allowing the amount of tissue to be removed to be controlled. This may be achieved by inserting into the cavity a spacer selected from a set of differently sized spacers or by moving a movable member (such as a base 26 or wall) which defines a portion of the cavity. The actuator for moving the movable member may be mechanical or hydraulic. Thus the actuator may be a wire (30, figure 3), the movable member being supported on one or more hinged struts (28, figures 3 and 4); or hydraulic pistons (not shown); or an inflatable platform (34, figures 5 and 6) that carries the movable member and which may be inflated with a gas or liquid, or with a substance that can be caused to expand by means of a chemical or thermal reaction. The movable member may thereby be moved between an extended position and a retracted position in a controlled manner.

A suction device may be provided for removing air from the cavity (eg via holes 22) such that tissue inserted into the cavity may be sucked inwardly and held securely in place.

The device may also be associated with imaging means, eg in a channel below the cavity, to provide real time images of the tissue in the cavity. Thus the device may form part of an endoscope.

The device may be used to remove submucosal or mucosal tumours or cancer in the gastrointestinal tract.

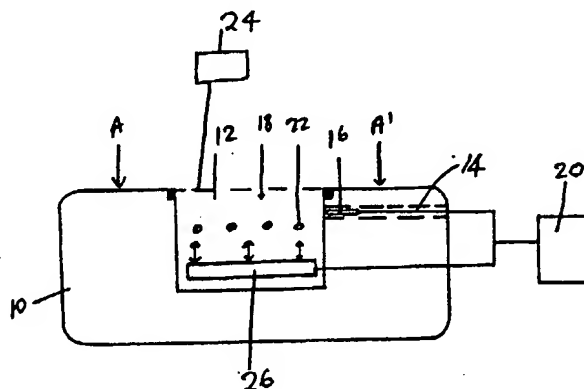


Figure 1

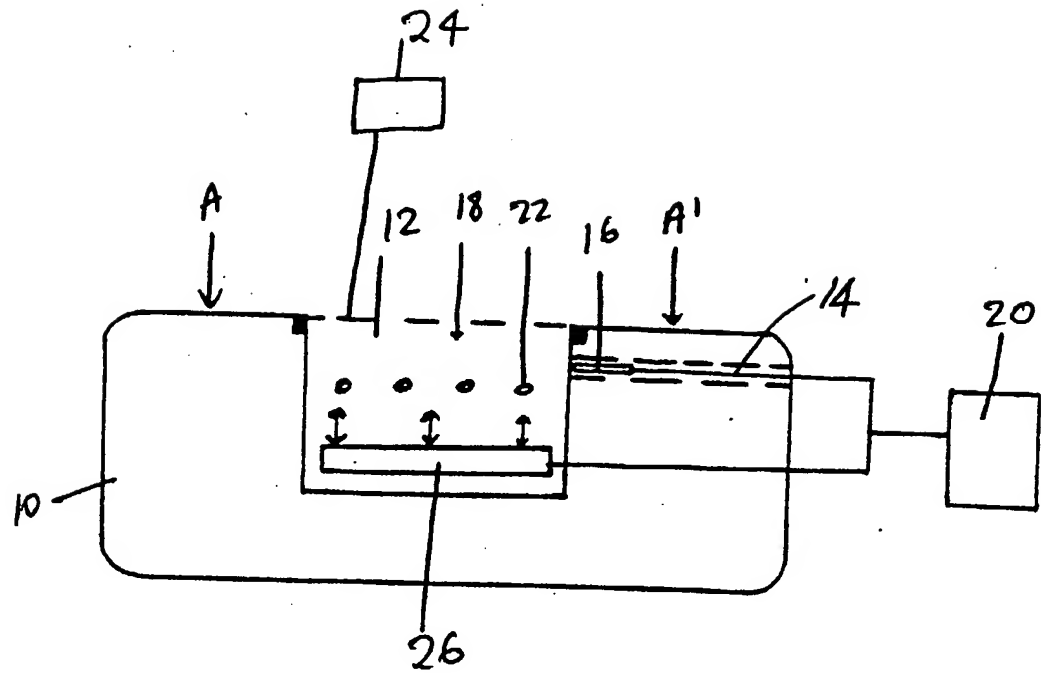


Figure 1

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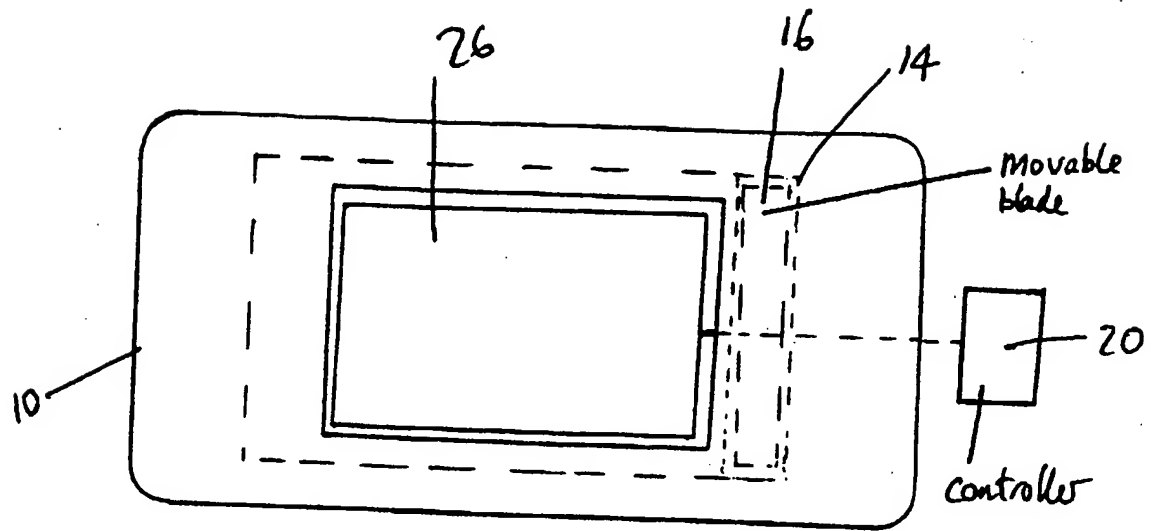


Figure 2

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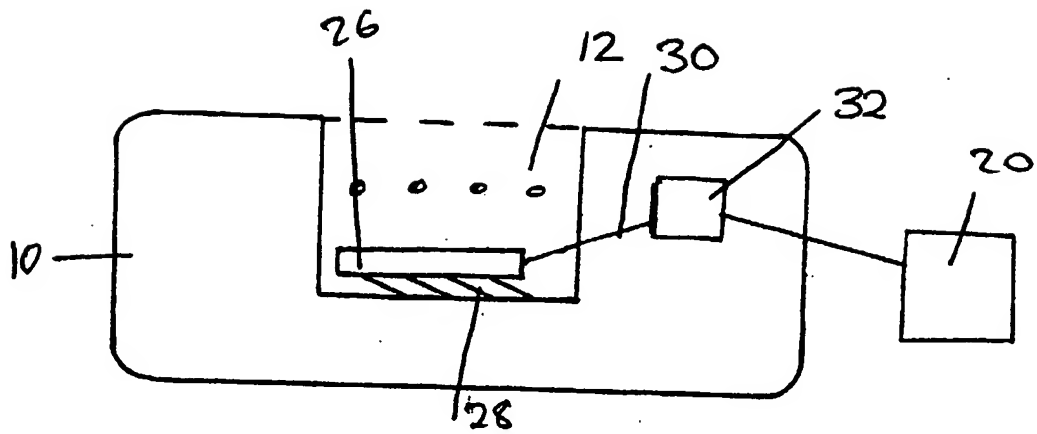


Figure 3

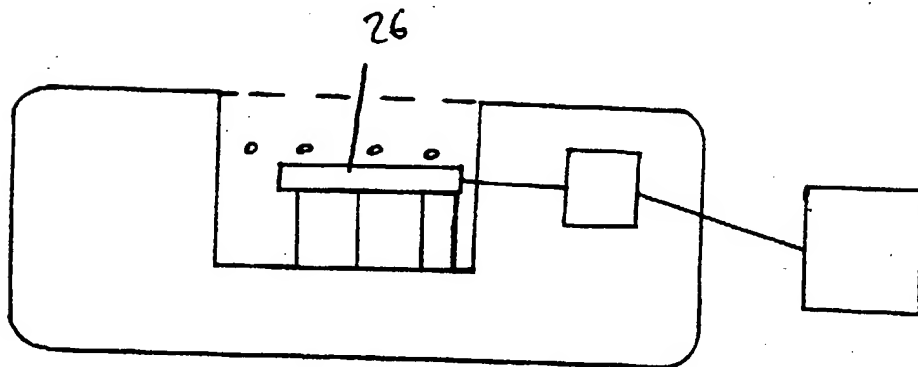


Figure 4

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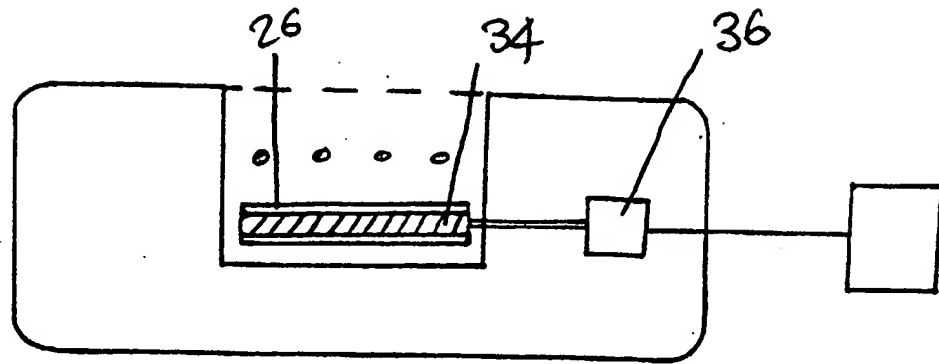


Figure 5

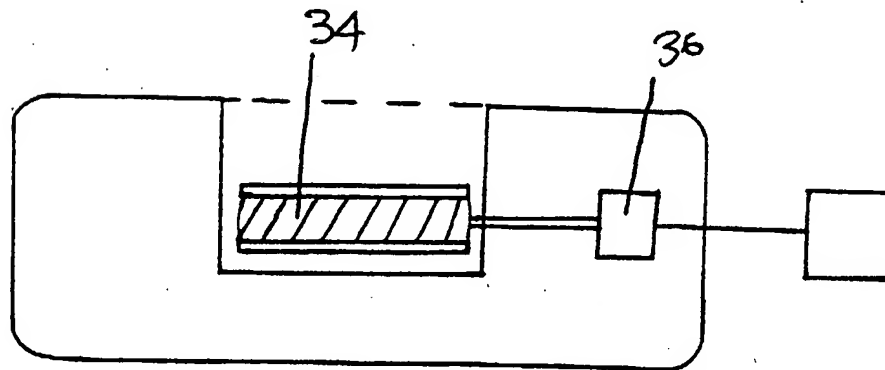


Figure 6

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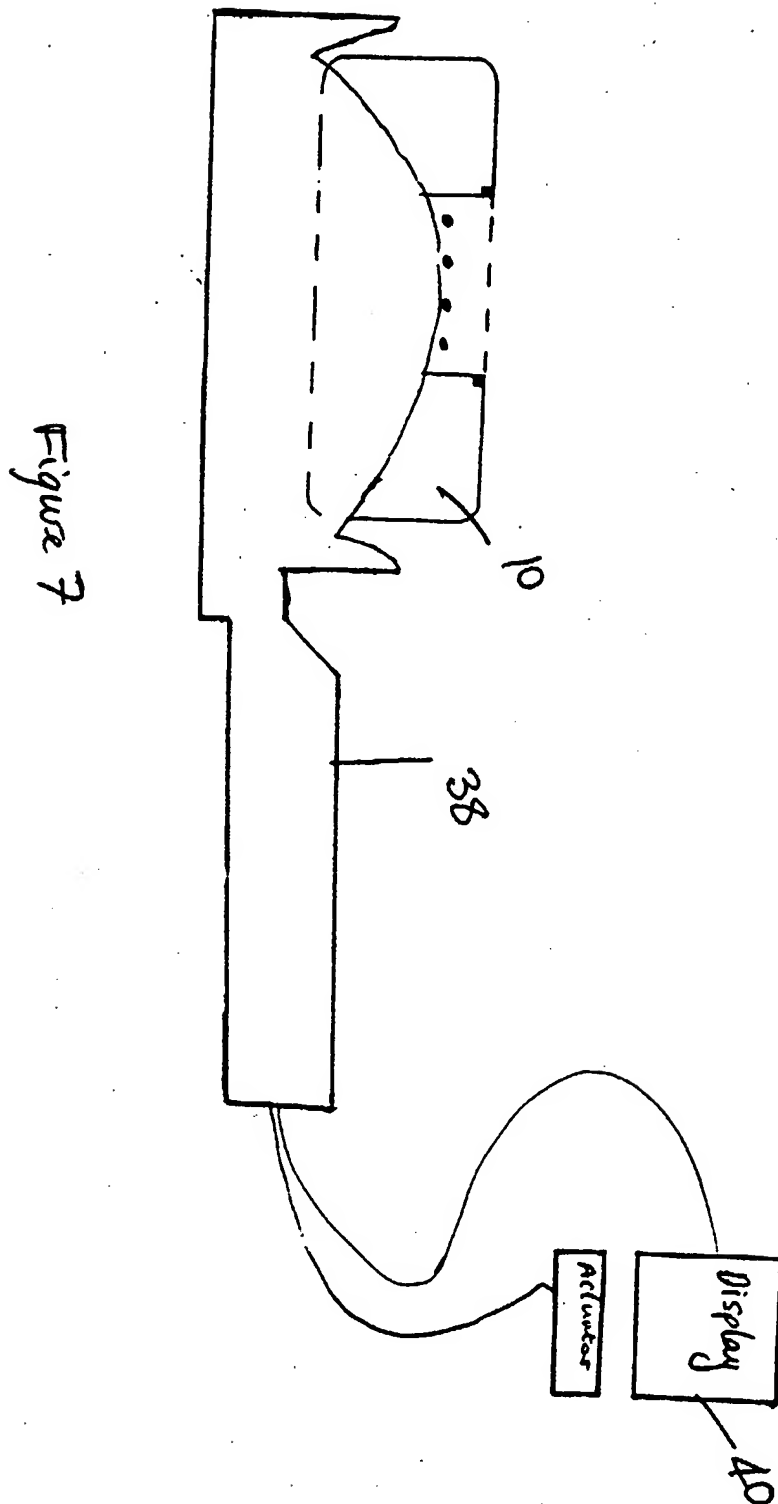


Figure 7

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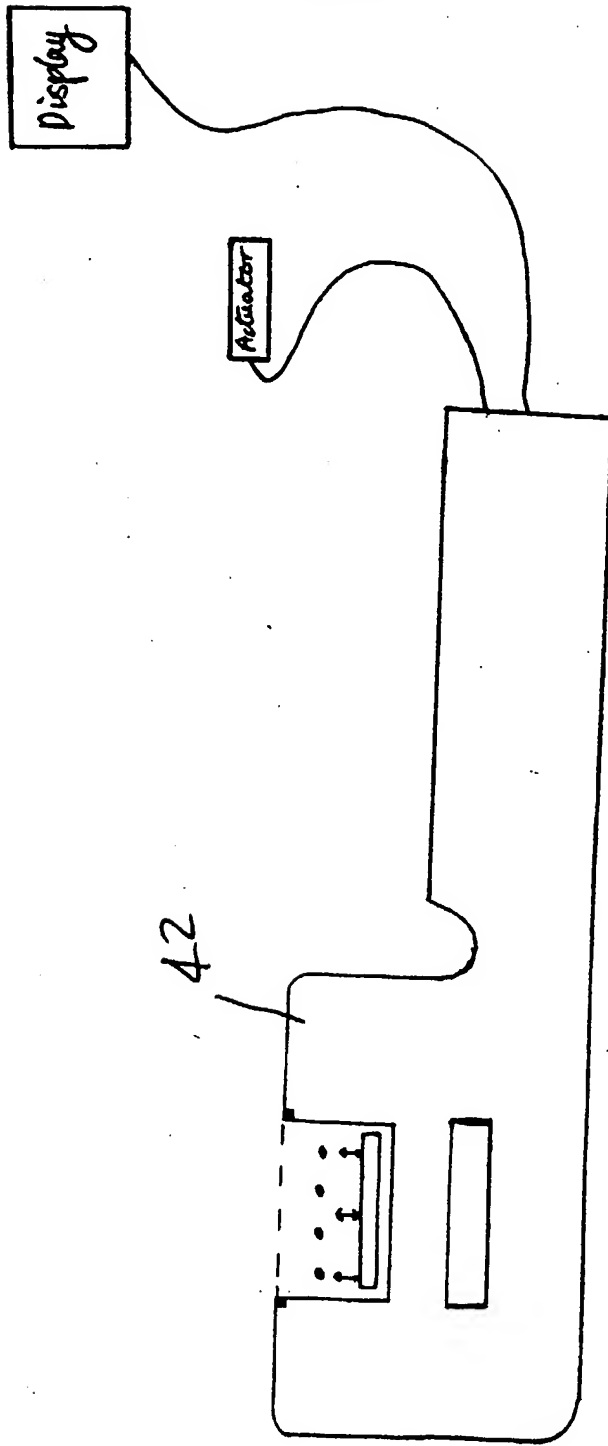


Figure 8



**A MEDICAL DEVICE FOR REMOVING TISSUE**

5 The present invention relates to a medical device that is operable to remove tissue from a patient, such as submucosal or mucosal tumours or cancer in, for example, the gastrointestinal tract.

10 Various devices for removing tissue are known. In one such device a snare is closed around the tissue that is to be removed and an electrodathermy current passed through the snare in order to cut away the unwanted material. A disadvantage of this arrangement is that if the cut is too deep, there is a danger of causing damage to the patient.

15 An object of the present invention is to provide an improved device for cutting tissue from a patient.

20 According to a first aspect of the present invention there is a medical device for removing tissue comprising a body portion that defines a cavity for receiving tissue and means for removing the tissue received in the cavity.

Preferably, means are provided for varying the volume of the cavity

25 An advantage of this device is that the amount of tissue that can be received in the cavity is variable. This means that the doctor has control over the amount of tissue that is inserted into the cavity and so removed by the means for cutting, thereby limiting the risk to the patient.

The means for varying the volume of the cavity may comprise a spacer that can be inserted into the cavity. Preferably, a plurality of different sized spacers are provided.

5 Preferably, a movable member is provided to define a portion of the cavity and the means for varying the volume are operable to move the movable member relative to the body portion. The movable member may define a base or wall of the cavity.

10 Preferably, the means for varying the volume comprise an actuator that is operable to cause the movable member to move. Preferably, the actuator is connected to a controller that automatically causes the actuator to move the movable member as and when desired by the physician. Preferably, the controller includes computer software for controlling the actuator. The actuator  
15 may be mechanical or hydraulic.

The actuator may comprise a hinged strut that carries the movable member and is movable between a retracted position and an extended position. A plurality of hinged struts may be provided.

20

The actuator may comprise an inflatable platform that carries the movable member and means for inflating it, for example, by filling it with a gas or liquid, the inflation of the platform moving the movable member from a retracted position to an extended position. Alternatively, the inflatable platform may  
25 contain a substance that at a controlled time can be caused to expand by means of a chemical or thermal or some other reaction.

The means for removing the tissue received in the cavity may comprise a blade or a guillotine or a snare, with or without electrocoagulation input.

5 Preferably a suction device is provided in fluid communication with the cavity for removing air therefrom in use. An advantage of this is that tissue that is inserted into the cavity can be sucked inwardly and so held securely in place.

10 Preferably, the device further includes imaging means for providing real time images of the tissue in the cavity. The imaging means may be operable to delineate tissue layers and/or tissue composition and/or the cell type of the tissue. The imaging means may be operable to effect real time ultrasound and/or optical coherence tomography. The imaging means may be located in a channel below the cavity.

15 According to another aspect of the present invention there is provided an endoscope or imaging device that is provided with a medical device according to the first aspect of the invention.

20 Preferably, the medical device forms an integral part of the endoscope or imager.

Preferably, the endoscope or imaging device is operable to provide images of the tissue in the cavity of the medical device.

25 According to yet another aspect of the present invention, there is provided a kit comprising a plurality of devices for removing tissue, each device having a body portion that defines a cavity for receiving tissue and means for removing

the tissue received in the cavity, wherein each device has a cavity of a different size.

5 Various devices in which the present invention is embodied will now be described by way of example only and with reference to the following drawings of which,

Figure 1 is a cross-section through a tissue resection device;

Figure 2 is a view on the line A-A' of Figure 1;

10 Figure 3 is a cross-section through a resection device having a first arrangement for varying the volume of the cavity, which is shown in a retracted position;

Figure 4 is a cross-section similar to that of Figure 3, in which the first arrangement is shown in an extended position;

15 Figure 5 is a cross-section through a resection device with a second arrangement for varying the volume of the cavity, which second arrangement is shown in a retracted position;

Figure 6 is a section similar that of Figure 5 in which the second arrangement is shown in an extended position;

20 Figure 7 shows an endoscope on which a resection device is mounted, and

Figure 8 is an endoscope that incorporates a resection device.

25 Figure 1 shows a resection device that has a main body portion 10 in which is defined a cavity 12 that is provided for receiving tissue that is to be removed from a patient. Formed through the body portion 10 is a channel 14 that is adapted to receive a blade 16 that is operable in use to move over the mouth 18

of the cavity 12, thereby to remove tissue that is located therein. Of course, any other suitable cutting means, such as a snare, could be used. Connected to the blade 16 is a controller 20 for causing the blade to move on receipt of the appropriate signal.

5

In order to assist with the location of tissue in the cavity, holes 22 are provided through the body portion 10, which holes 22 open into the cavity 12. Connected to the body portion 10 is a suction device 24 that is operable to suck air from the cavity 12 via the holes 22. In this way, the tissue can be more  
10 securely drawn into the cavity 12.

Located in the cavity is a movable base 26 that is connected to the controller 20 that is operable to cause the base to move, thereby to vary the volume of the cavity 12. Various means may be provided for moving the base 26.

15

Figure 3 shows one example of a movable base 26 in which the base member 26 is mounted on a plurality of hinged struts 28 that are connected to the body portion and are movable between a retracted position and an extended position. Connected to the base member 26 is a wire 30, which is in turn connected to an  
20 actuator 32 that is operable to pull on the wire or release it, as and when desired under the control of the controller 20. When pulled by the actuator 32, the wire 30 is tensioned and acts against the base 26. This causes the struts 28 to pivot about their hinges and move between the retracted position shown in Figure 3 and the extended position shown in Figure 4. Likewise, when the wire 30  
25 is released from its tensioned state, this causes the struts 28 to pivot about their hinges and move from their extended to their retracted position. The level to which the base member 26 is raised or lowered can be controlled as desired,

thereby to vary the volume of the cavity 12.

Figure 5 shows another device, in which the base member 26 is mounted on an inflatable platform 34. Connected to the inflatable platform 34 is a fluid supply 36, typically an air supply, that can be controlled to inflate it, thereby moving the base member 26 from a retracted position as shown in Figure 5 to an extended position as shown in Figure 6. The air supply 34 can equally be controlled to deflate the platform, thereby moving the base member 26 from its extended position to its retracted position. In this way, the position of the base member 26 can be varied, thereby to vary the volume of the cavity 12.

Of course, various other methods can be used. For example, hydraulic pistons could be positioned under the base member, for moving it towards and away from the base of the body portion. Alternatively, the platform could be mounted on and between two triangular blocks that are movable together or on an articulated platform. In any case, by moving the base member, the volume of the cavity can be varied.

In use, the tissue that is to be removed is placed in the cavity 12 and the suction device is activated to suck the material inwardly against the cavity walls. The physician then inspects the inserted tissue. In the event that the cavity 12 is not big enough to accommodate all of the material that is to be removed, the physician increases the volume of the 12 cavity by moving the base member 26 towards the base of the body portion, thereby to accommodate any excess. Alternatively, if after the initial inspection, there is material in the cavity 12 that is not to be removed, the physician decreases the volume of the cavity 12 by moving the base member 26. Once the correct amount of tissue is located

within the cavity 12, the controller causes the blade 16 to be drawn across the mouth of the cavity 12 and the unwanted material is removed.

5       Whilst the devices described with reference to Figures 3 to 6 include a movable base 26, as yet another example, the volume of the cavity 12 could be varied by providing a plurality of different sized spacers. In this case, the appropriate spacer would be selected by the physician and inserted into the cavity 12.

10       The resection device described above can be mounted on the end of an endoscope or an imaging device 38, such as an ultrasound probe, as shown in Figure 7. In this way, the tissue in the cavity 12 can be viewed by the physician on the endoscope or imaging device screen or display 40. Alternatively the device could be incorporated directly into an imaging device 42, as shown in Figure 8. In this example the imaging transducer or probe is located directly  
15       below the tissue cavity. Again, an image of the tissue in the cavity can be obtained. As yet another option, the device could include miniaturised imaging transducers or probes in a channel below the cavity. In any case, a controller is provided with an actuator that can be varied by the physician in order to vary the volume of the tissue cavity by a selected amount.

20

When the endoscope or imaging device of Figure 7 and 8 is used, the physician can remotely remove internal tissue, for example, in the gastrointestinal tract. In this case, the device is introduced into the patient and guided towards the tissue that is to be removed, whilst viewing images on the display. As before,  
25       tissue that is to be removed is placed in the cavity and the suction device is activated to suck the material inwardly against the cavity walls. Images of the tissue in the cavity are displayed on the device screen. This enables the

physician to check that the material that is to be removed is located in the cavity. In the event that the cavity is not big enough to accommodate all of the material that is to be removed, the physician varies the actuator to increase the volume of the cavity by moving the base member towards the base of the body portion, thereby to accommodate any excess. Alternatively, if after the initial inspection, there is material in the cavity that is not to be removed, the physician varies the actuator to decrease the volume of the cavity by moving the base member away from the body portion. The tissue images on the display are continuously checked during this process until the physician is satisfied that the desired tissue is located within the cavity. Once this is done, the blade is drawn across the mouth of the cavity and the unwanted material is removed.

The resection device described herein can be manually operated or automatically operated under computer control.

A skilled person will appreciate that variations of the disclosed arrangements are possible without departing from the invention. Accordingly, the description of the specific embodiments is made by way of example and not for the purposes of limitation. It will be clear to the skilled person that minor modifications can be made without significant changes to the operation described above.



**Claims**

1. A medical device for removing tissue comprising a body portion that defines a cavity for receiving tissue and means for removing the tissue received  
5 in the cavity.

2. A medical device as claimed in claim 1 comprising means for varying the volume of the cavity.

10 3. A medical device as claimed in claim 2, wherein the means for varying the volume of the cavity comprise a spacer that can be inserted into the cavity.

4. A medical device as claimed in claim 3, wherein a plurality of different sized spacers are provided.  
15

5. A medical device as claimed in claim 2, wherein a movable member is provided to define a portion of the cavity and the means for varying the volume are operable to move the movable member relative to the body portion.

20 6. A medical device as claimed in claim 5, wherein the movable member defines a base or wall of the cavity.

7. A medical device as claimed in claim 5 or claim 6, wherein the means for varying the volume comprise an actuator that is operable to cause the movable  
25 member to move.

8. A medical device as claimed in claim 7, wherein the actuator is connected

to a controller that automatically causes the actuator to move the movable member as and when desired by the physician.

5 9. A medical device as claimed in claim 8, wherein the controller includes computer software for controlling the actuator.

10. A medical device as claimed in any one of claims 7 to 9, wherein the actuator is mechanical or hydraulic.

10 11. A medical device as claimed in any one of claims 7 to 10, wherein the actuator comprises a hinged strut that carries the movable member and is movable between a retracted position and an extended position.

15 12. A medical device as claimed in claim 11, wherein a plurality of hinged struts are provided.

20 13. A medical device as claimed in any one of claims 7 to 10, wherein the actuator comprises an inflatable platform that carries the movable member and means for inflating it, for example, by filling it with a gas or liquid, wherein inflation of the platform causes movement of the movable member from a retracted position to an extended position.

25 14. A medical device as claimed in claim 13, wherein the inflatable platform contains a substance that is expandable by means of a chemical or thermal or some other reaction.

15. A medical device as claimed in any one of the preceding claims wherein

the means for removing the tissue received in the cavity comprise a blade or a guillotine or a snare, with or without electrocoagulation input.

5. 16. A medical device as claimed in any one of the preceding claims, wherein a suction device is provided in fluid communication with the cavity for removing fluid, e.g. air, therefrom in use.

- 10 17. A medical device as claimed in any one of the preceding claims further including imaging means for providing real time images of tissue in the cavity.

18. A medical device as claimed in claim 17, wherein the imaging means are operable to delineate tissue layers and/or tissue composition and/or the cell type of the tissue.

- 15 19. A medical device as claimed in claim 17 or claim 18, wherein the imaging means are operable to effect real time ultrasound and/or optical coherence tomography.

- 20 20. A medical device as claimed in claim 17 or claim 18 or claim 19, wherein the imaging means are located in a channel below the cavity.

21. An endoscope or imaging device that includes a medical device as claimed in any one of the preceding claims, preferably wherein the medical device forms an integral part of the endoscope or imager.

- 25 22. An endoscope or imaging device, wherein the endoscope or imaging device is operable to provide images of tissue in the cavity of the medical

device.

23. A kit comprising a plurality of devices for removing tissue, each device having a body portion that defines a cavity for receiving tissue and means for  
5 removing the tissue received in the cavity, wherein each device has a cavity of a different size.

24. A medical device substantially described hereinbefore with reference to the accompanying drawings and as shown in Figure 1 and Figure 2 or Figure 3  
10 and Figure 4 or Figure 5 and Figure 6.

25. An endoscope or imaging device substantially as described hereinbefore with reference to the accompanying drawings and as shown in Figure 7 and  
15 Figure 8.